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E665

Jet Rates from Deep Inelastic Muon Scattering in the W Range of 15 to 35 GeV

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ABSTRACT

Production rates of forward jets in deep inelastic muon scattering are studied using the JADE jet finding algorithm. The evolution of di-jet rates with W is compared to QCD first order predictions in the W range of 15 to 35 GeV.

1. Introduction

The E665 experiment¹ at the Tevatron muon beamline of Fermilab is able to collect data in a regime where final-state QCD corrections to Deep Inelastic Scattering (DIS) become measurable. First order QCD corrections to the DIS parton model predicts, via gluon bremsstrahlung (qg) and photon-gluon fusion ($q\bar{q}$), di-jet production in the forward direction.² The cross sections for the production of $q\bar{q}$ and qg events have been calculated to first order in α_s .³ To overcome collinear and soft singularities an invariant mass cut is introduced in these calculations defining the resolvability of the parton pairs. In contrast to e^+e^- jet production, the parton densities are involved in the DIS jet cross section calculations. Furthermore, DIS di-jet production depends on the gluon density inside the hadron target through the $q\bar{q}$ process. Using cuts based on the expected topology for di-jet events, the E665 collaboration has already presented evidence for the production of di-jets in the forward hemisphere.^{4,5} This contribution presents the study of forward jets using a jet definition algorithm that does not use *a priori* knowledge of the DIS di-jet topology.

2. Event Selection

The data sample used for this analysis was taken during the 1987-88 Fermilab fixed-target run, scattering 490 GeV muons on a 1.12m long H_2 target. To enhance the DIS sample the following kinematic cuts were applied: $Q^2 > 2.5 \text{ GeV}^2$; $\nu \geq 40 \text{ GeV}$; $x_{Bj} > 0.003$ and $0.05 \leq y_{Bj} \leq 0.95$. A further cut was used to reduce the contribution of photon bremsstrahlung: events with $\nu > 200 \text{ GeV}$ and $E_{\text{calorimeter}}/\nu > 0.35$ were considered to be bremsstrahlung. All charged particles reconstructed in the tracking

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system and fitted to the vertex and all neutral particles reconstructed in the calorimeter were used. The final total sample was about 17000 events. The jet finding algorithm introduced by the JADE collaboration⁶ was used to define the number of jets in an event. The "squared invariant mass" of a hadron pair, scaled by the squared total c.m.s visible energy in the event (E_{vis}^2) was used by the algorithm. Since a reasonable acceptance on E_{vis} was not reached until $W = 15$ GeV (70%), only events with $W \geq 15$ GeV were considered.

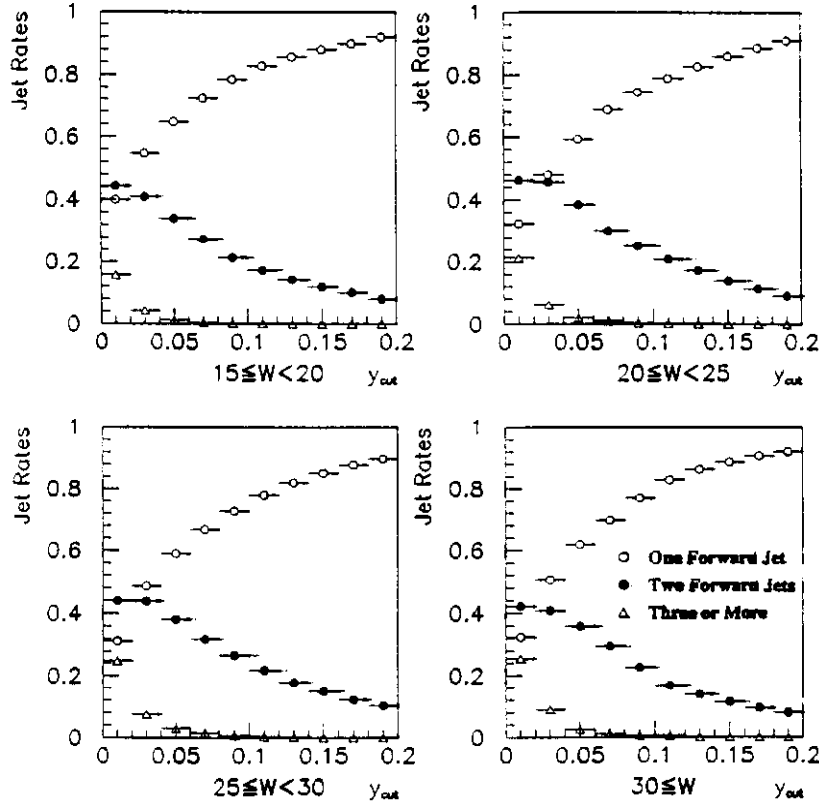


Fig. 1 : Jet rates versus y_{cut} . Data have not been corrected for acceptance.

3. Jet Rates

Figure 1 shows the rates of one, two and more than two forward jets versus the resolution parameter in the algorithm, y_{cut} . The data have not been corrected for acceptance. Rates measured for di-jet production are compared with QCD predictions. Figure 2 shows di-jet event rates versus W for $y_{cut} = 0.08$. This value, taking into account our energy acceptance, was chosen to approximately match the value used in the QCD predictions,⁷ also shown in figure 2. In spite of the fact that fragmentation and acceptance corrections are not included, rate levels of data and predictions are reasonably close. Applying the JADE algorithm with a value of $y_{cut} = 0.08$, two samples: (I) "one-jet" sample (4011 events) and (II) "two-jets" sample (2021 events) were created.

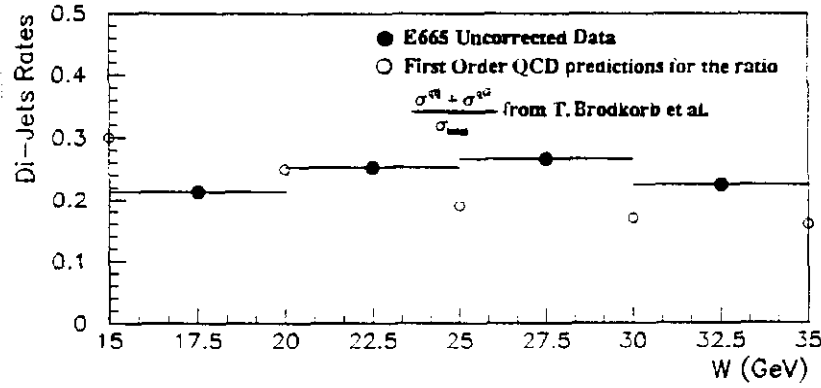


Fig. 2 : Jet rates versus W . Data (not corrected for acceptance) are compared to first order QCD predictions for the ratio $\sigma_{q\bar{q}} + \sigma_{qg} / \sigma_{total}$.[†]

The topological properties of these two samples agree with the expectation of having an enriched sample of two jets events in sample (II). As an example, figure 3 shows, for each sample, the energy flow of the hadrons projected on the hadronic plane. ψ is the angle between the virtual photon direction and the hadron momentum projection into the hadronic plane.

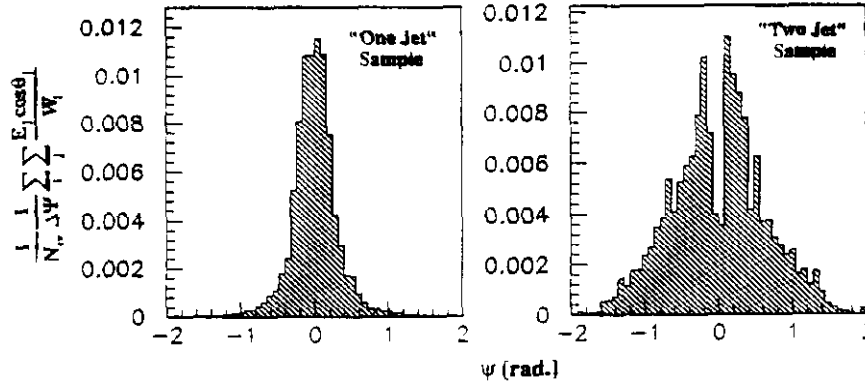


Fig. 3 : Energy flows for the "one-jet" and "two-jets" samples.

4. Conclusions

Di-jet like events were found in DIS events using the JADE jet finding algorithm on forward produced hadrons for $W \geq 15$ GeV. Their rates compare qualitatively well with QCD predictions.

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